PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Availability of Equipment and Medications for Non-Communicable Diseases and Injuries at Public First-Referral Level Hospitals: A Cross-sectional Analysis of Service Provision Assessments in Eight Low-Income Countries
AUTHORS	Gupta, Neil; Coates, Matthew; Bekele, Abebe; Dupuy, Roodney; Fénelon, Darius Leopold; Gage, Anna; Getachew, Theodros; Karmacharya, Biraj; Kwan, G.; Lulebo, Aimée; Masiye, Jones; Mayige, Mary; Ndour Mbaye, Maïmouna; Mridha, Malay Kanti; Park, Paul; Dagnaw, Wubaye; Wroe, Emily; Bukhman, Gene

VERSION 1 – REVIEW

REVIEWER	Michael Engelgau National Institutes of Health
REVIEW RETURNED	15-Apr-2020

GENERAL COMMENTS	Reviewer Comments Title: Availability of Equipment and Medications for Non-Communicable Diseases and Injuries at Public First-Referral Level Hospitals: A Cross-sectional Analysis of Service Provision Assessments in Eight Low-Income Countries Authors: Gupta N, et al Overview The authors conducted a study using Demographic and Health Survey data from 8 LICs. They examined the first level referral health care delivery unit (the one just above primary care services) and determined availability of equipment, supplies, and medications needed to deliver services for acute and chronic care for NCDIs and surgery for 11 medical situations. They found few facilities were fully equipped and supplied to address acute and chronic care needs. The authors also examined severity of local poverty and these indicators and found no clear relationship. General Comments This is an important topic in LICs and the authors should be commended for this work. This study has clear methods and results. However, there are some areas where the manuscript could be improved. These include: the variation in the year of the DHS date from each country, provision of a more clear rationale why these countries were included, understanding the role of the private health care system, more discussion and examination of staffing and skills needed to deliver these services, better understanding of where NCD services are provided within the health care systems, more discussion on how the variability of the health systems across countries may affect the results, further consideration of essential items for some conditions, and more

	consideration on the ability to treat acute disease but not able to manage them chronically. The variation in the year of the data across countries needs further attention. The range seems to be from 2014 to 2018. Some discussion on how this might affect the finding would be useful. Specially, were countries with older data doing worse that others with newer data in some areas. Also, especially with older data, the countries may have invested efforts (we hope they have) to fill some of these deficiencies than those with newer studies. Some discussion of how these countries were selected would be useful. Also, more on the denominator of all LICs would be useful to see what the coverage of this sample actually is. It seems that these countries are the only LICs that have this data currently. Some mention of why they did these surveys and many other have not, would be useful. Private health care can account for a large proportion of care across LICs, especially in the primary care and lower-level referral care. More clarity of how this was handled would be useful. Potentially, some of the public institutions were not equipped because their use was low, etc. In addition, there is a finding that some countries (e.g. Bangladesh) does not treat NCD at the upazila level which was included for the study. More explanation would be helpful. Staffing will skill sets able to deliver these services are critical. This is noted in the discussion as a very important point. The DHS does include elements of human resources. This is an very important part of the situation to consider. Some countries may not have supplies because they are not staffed to deliver them (maybe the case in Bangladesh). Also, it may make the finds even worse. However it would provide a more clear picture of the challenges found. Finally, you do not want counties to use these finding to stock up on deficient items when they don't have staff to delivery them. In Table 1, the elements of essential equipment, supplies, and medications are presented. These listed were developed from guidelines and expert input. A few things to consider in addition would be: acute asthma to include epinephrine, CHF to in xray, and diabetes to include portable test strips and glucometers. Specific Comments • The title could be shorted and should also indicate that the conditions include (some) surgery also. • The poverty correlation analyses does not seem to add much and the findings could be provided very briefly.

REVIEWER	David Spiegel University of Pennsylvania, USA
REVIEW RETURNED	20-Apr-2020

GENERAL COMMENTS	I really enjoyed reading this very interesting, well written and thorough study concerning availability of essential equipment and supplies for the treatment of NCD's at primary level facilities in LMICs. Were the specific diagnoses studied those NCD's with the highest burden in LMICs? Findings suggest that primary health

	facilities are simply not maintained, and that complete sets of essential equipment and supplies are unavailable, not to mention human resources although this was not evaluated. It was interesting that availability did not correlate with poverty levels, but perhaps this just reflects a global challenges in the public health system independent of the wealth of different geographic domains. I was also curious why authors elected to grade availability as "all or none", which does not capture the nature and magnitude of deficiencies….for example a facility that had 90% of core elements would be classified as not available. In a world where support for health service delivery is often in vertical silos, NCD's like surgical care are horizontal, and require functional system to deliver services. Specific comments: Introduction is very well written. Given breadth of NCDs, what is unique about the resources required to treat these above and beyond general preventive and curative medical services? These could be a proxy for availability of medical and surgical services or for a health system. Makes sense to evaluate availability for selected conditions or diagnoses. Line 130. Why was surgical care selected as this represents a range of services to treat an enormous number of conditions rather than specific diagnoses or conditions? Line 137. The raw data is available? These surveys appear similar to the WHO's SAM or SARA which are used in a number of countries. Lines 148-154, 164. This section is a bit confusing, but in essence 7/8 included data on public and private facilities (3 surveyed all facilities and 4 presented a sample of all facilities), one sampled public hospitals, and one sampled public only. So did you then delete. The data on private facilities from your dataset? Any thought given to comparing the public and private facilities, might hypothesize that private had better availability, and if so would show in stronger way the deficiencies in public sector facilities. Line 187-188. So it's all or none, if a single component is unavailable then whole set unavailable? Did you consider reporting the percentage of essential items available on the day of evaluation? For example in the WHO's SARA methodology the data is reported according to availability and "readiness" scores. Table 1. Under injury and surgical care could have considered something related to anaesthetic care, for example availability of endotracheal tube or anaesthesia machine. One of the rate limiting steps for surgical care is certainly availability of anaesthesia. Line 222. Do you mean the percentage of essential items on the day of evaluation at the facility? Line 239. Which of the NCD's require surgical care at the primary referral level? How about the availability versus self-reported availability of surgical equipment (Table 4). Lines. 430-431. Since surgery is considered here you might consider comparing your findings with an 8 country study on surgical service availability and readiness in Sub Saharan Africa based upon Service Availability and Readiness Assessment data from WHO, findings were very similar (BMJ Open 2017;7:e014496). The term readiness is used in line 430, not sure how this is being defined relative to availability.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Reviewer Name
Michael Engelgau

Institution and Country
National Institutes of Health

Please state any competing interests or state 'None declared':
None

Please leave your comments for the authors below
Reviewer Comments
Title: Availability of Equipment and Medications for Non- Communicable Diseases and Injuries at Public First-Referral Level Hospitals: A Cross-sectional Analysis of Service Provision Assessments in Eight Low-Income Countries
Authors: Gupta N, et al

Overview
The authors conducted a study using Demographic and Health Survey data from 8 LICs. They examined the first level referral health care delivery unit (the one just above primary care services) and determined availability of equipment, supplies, and medications needed to deliver services for acute and chronic care for NCDIs and surgery for 11 medical situations. They found few facilities were fully equipped and supplied to address acute and chronic care needs. The authors also examined severity of local poverty and these indicators and found no clear relationship.

General Comments
This is an important topic in LICs and the authors should be commended for this work. This study has clear methods and results. However, there are some areas where the manuscript could be improved. These include: the variation in the year of the DHS date from each country, provision of a more clear rationale why these countries were included, understanding the role of the private health care system, more discussion and examination of staffing and skills needed to deliver these services, better understanding of where NCD services are provided within the health care systems, more discussion on how the variability of the health systems across countries may affect the results, further consideration of essential items for some conditions, and more consideration on the ability to treat acute disease but not able to manage them chronically.

The variation in the year of the data across countries needs further attention. The range seems to be from 2014 to 2018. Some discussion on how this might affect the finding would be useful. Specially, were countries with older data doing worse that others with newer data in some areas. Also, especially with older data, the countries may have invested efforts (we hope they have) to fill some of these deficiencies than those with newer studies.

Thank you for this comment. We have added to the Discussion, ninth paragraph (limitations paragraph), a new sentence which reads: "Sixth, the year of survey data collection varied amongst countries, which may limit direct comparison, and the results may underestimate current levels of availability if substantial improvements have been made following the data collection period, particularly in countries with older surveys."

Some discussion of how these countries were selected would be useful. Also, more on the denominator of all LICs would be useful to see what the coverage of this sample actually is. It seems that these countries are the only LICs that have this data currently. Some mention of why they did these surveys and many other have not, would be useful.

Criteria on the selection of the countries included in our analysis are presented in Methods, Study Setting and Data Sources, first paragraph, first sentence, which states: "We utilized publicly available data from all Service Provision Assessment (SPA) surveys conducted in LICs through 2018."

The countries included in this study together represent 19% of countries classified as LICs and 44% of the global population living in LICs. We have added this information to Methods, Study Setting and Data Sources, second paragraph, third sentence: "Bangladesh subsequently graduated to lower-middle income status in 2015, and Senegal was moved from a lower-middle-income country to a low-income country in 2017 and back to a lower-middle-income country in 2020. These countries, excluding Senegal and Bangladesh, together represent 19% of countries classified as LICs by the World Bank for the 2020 fiscal year and 44% of the global population living in LICs."

Unfortunately, there is no public information on the determining factors for which LICs conduct SPA surveys and which do not. Our understanding is that it is likely due to a complex intersection of governance and financing decisions. Given the broad mix of countries included in this analysis representing a substantial portion of the overall LICs and global LIC population, we believe that our findings are likely generalizable to LIC countries more broadly.

Private health care can account for a large proportion of care across LICs, especially in the primary care and lower-level referral care. More clarity of how this was handled would be useful. Potentially, some of the public institutions were not equipped because their use was low, etc. In addition, there is a finding that some countries (e.g. Bangladesh) does not treat NCD at the upazila level which was included for the study. More explanation would be helpful.

We thank the reviewer for this insightful comment, which correctly specifies the interpretation of our findings. In Methods, Study Setting and Data Sources, third paragraph, we have added the following sentence: "We limited our analysis to public-sector facilities to optimize evaluation of health system investment and capacities provided from government sources for the poorest segment of the population, though data is not available within SPA surveys to specify payment source and mechanism for each commodity or service provided."

We agree that public-sector health facilities may suffer from inadequate investment leading to low utilization as well as low utilization that further leads to inadequate revenue, which likely results in higher demand and utilization for private sector facilities. The objective of our analysis was to study the public-sector capacities rather than directly compare public-sector and private-sector facilities, which is likely out of the scope of this study.

Staffing will skill sets able to deliver these services are critical. This is noted in the discussion as a very important point. The DHS does include elements of human resources. This is an very important part of the situation to consider. Some countries may not have supplies because they are not staffed to deliver them (maybe the case in Bangladesh). Also, it may make the finds even worse. However it would provide a more clear picture of the challenges found. Finally, you do not want counties to use these finding to stock up on deficient items when they don't have staff to delivery them.

We thank for the reviewer for this comment, and we agree that lack of adequate human resources further exacerbates the provision of appropriate care for severe chronic diseases in these settings. To further emphasize this point, we have added to the limitations paragraph an additional sentence that reads: "The availability of essential equipment and medications presented in this analysis may therefore overestimate the overall service availability for the corresponding condition."

In Table 1, the elements of essential equipment, supplies, and medications are presented. These listed were developed from guidelines and expert input. A few things to consider in addition would be: acute asthma to include epinephrine, CHF to in xray, and diabetes to include portable test strips and glucometers.

We agree with the reviewer that epinephrine may be considered by some guidelines in the minimum set of medications for the management of acute asthma. In the limitations section, we have noted, "Third, the components of these sets of equipment and medications may not be comprehensive of all items needed for care associated with each disease condition, but rather represent a core number of elements measured within the available survey tools." Overall, the very low rate of availability of the essential set of medications and equipment for asthma would not change with the inclusion of epinephrine.

As we focused on chronic care of heart failure rather than acute management, we did not include chest X-ray as an essential diagnostic test. For diabetes, we included blood glucose testing though did not specify by which diagnostic procedure according the SPA survey methodology.

Specific Comments

- The title could be shorted and should also indicate that the conditions include (some) surgery also.

Thank you for this suggestion. The title includes reference to "Injuries" in addition to "Non-communicable Diseases" to convey the breadth of conditions analyzed, including surgical conditions. We have attempted with the title to provide the reader with a concise description of both our topic and our methodology.

- The poverty correlation analyses does not seem to add much and the findings could be provided very briefly.

We agree that the null findings reported from the poverty correlation analysis are not the primary findings of the paper. However, given that this analysis was part of our original hypothesis and analytic plan, we feel it is important to accurate describe our methodology and findings from this analysis. We have attempted to shift most of this description to the supplementary materials (appendix).

Reviewer: 2
Reviewer Name
David Spiegel

Institution and Country
University of Pennsylvania, USA

Please state any competing interests or state ‘None declared’:
none

Please leave your comments for the authors below
I really enjoyed reading this very interesting, well written and thorough study concerning availability of essential equipment and supplies for the treatment of NCD’s at primary level facilities in LMICs. Were the specific diagnoses studied those NCD’s with the highest burden in LMICs? Findings suggest that primary health facilities are simply not maintained, and that complete sets of essential equipment and supplies are unavailable, not to mention human resources although this was not evaluated. It was interesting that availability did not correlate with poverty levels, but perhaps this just reflects a global challenges in the public health system independent of the wealth of different geographic domains.
I was also curious why authors elected to grade availability as “all or none”, which does not capture the nature and magnitude of deficiencies….for example a facility that had 90% of core elements would be classified as not available. In a world where support for health service delivery is often in vertical silos, NCD’s like surgical care are horizontal, and require functional system to deliver services.

Specific comments:
Introduction is very well written. Given breadth of NCDs, what is unique about the resources required to treat these above and beyond general preventive and curative medical services? These could be a proxy for availability of medical and surgical services or for a health system. Makes sense to evaluate availability for selected conditions or diagnoses.

Line 130. Why was surgical care selected as this represents a range of services to treat an enormous number of conditions rather than specific diagnoses or conditions?

We thank the review for this comment. In order to clarify this sentence, we have replaced “acute surgical care” with “injuries” to maintain consistency and focus on the particular clinical conditions of interest.

Line 137. The raw data is available? These surveys appear similar to the WHO’s SAM or SARA which are used in a number of countries.

Yes, the raw data for SPA surveys are available with registration online (reference #11 in manuscript). The surveys are indeed similar to WHO SARA.

Lines 148-154, 164. This section is a bit confusing, but in essence 7/8 included data on public and private facilities (3 surveyed all facilities and 4 presented a sample of all facilities), one sampled public hospitals, and one sampled public only. So did you then delete. The data on private facilities from your dataset? Any thought given to comparing the public and private facilities, might hypothesize that private had better availability, and if so would show in stronger way the deficiencies in public sector facilities.

Thank you for this observation. We intentionally limited our analysis to public-sector facilities to 1) focus on the role of government investment in health care services for the segment of the population (likely the poorest segment which is under- or uninsured and unable to pay out-of-pocket) which relies on subsidized public-sector services and 2) improve comparability/aggregation among the countries included in the analysis. Private sector facilities vary dramatically in financing, standards, quality, and oversight, and therefore would

complicate interpretation of findings. In Methods, Study Setting and Data Sources, third paragraph, we have added the following sentence: "We limited our analysis to public-sector facilities to optimize evaluation of health system investment and capacities provided from government sources for the poorest segment of the population, though data is not available within SPA surveys to specify payment source and mechanism for each commodity or service provided." A comparison of public-sector health system capacities to private or for-profit capacities would require more in-depth analysis at the level of each country, which is out of the scope of the current study.

Line 187-188. So it's all or none, if a single component is unavailable then whole set unavailable? Did you consider reporting the percentage of essential items available on the day of evaluation? For example in the WHO's SARA methodology the data is reported according to availability and "readiness" scores.

This is correct. In the current analysis, we attempted to define a "minimum" or "core" set of drugs and equipment that could be a minimally essential to provide adequate care for the condition. Therefore, we did treat the outcome measure of availability as a binary function. Please refer to the penultimate paragraph of the discussion where we discuss the potential limitations of readiness assessments currently used to monitor health systems. In addition, we provide proportions of facilities with proportions of particular components available in tables.

Table 1. Under injury and surgical care could have considered something related to anaesthetic care, for example availability of endotracheal tube or anaesthesia machine. One of the rate limiting steps for surgical care is certainly availability of anaesthesia.

We agree with the reviewer's comment that endotracheal intubation and anesthesia machine capability would be desirable in the management of major injuries. In the SPA survey, there are modules for "minor surgery" (which does not include these elements) and "Cesarean section" (which does include these elements). For the purposes of this analysis, we determined what we believed to be a minimum set of medications and equipment in order to provide a conservative estimate of health system capacity to address injuries, and we therefore limited our analysis to components from the "minor surgery" model. We have included that limitation in the Discussion limitations paragraph, which reads, "Third, the components of these sets of equipment and medications may not be comprehensive of all items needed for care associated with each disease condition, but rather represent a core number of elements measured within the available survey tools."

Line 222. Do you mean the percentage of essential items on the day of evaluation at the facility?

Yes. We have clarified the sentence to read as follows: "We counted the number of the individual components across our disease-related sets of medications and equipment (Table 1) that were available *on the day the survey was conducted* at each facility…"

Line 239. Which of the NCD's require surgical care at the primary referral level?
How about the availability versus self-reported availability of surgical equipment (Table 4).

We agree with the reviewer that we have not made clear the definition of conditions for which surgical care was assessed. We have attempted to improve this throughout the manuscript with the following changes by stating the condition as "injuries and minor surgical conditions" in the Introduction (third paragraph, second sentence), Table 1 (twelfth row, first column), Table 2 (22nd row, first column), and Discussion (seventh paragraph, first sentence).

Lines. 430-431. Since surgery is considered here you might consider comparing your findings with an 8 country study on surgical service availability and readiness in Sub Saharan Africa based upon Service Availability and Readiness Assessment data from WHO, findings were very similar (BMJ Open 2017;7:e014496).

Thank you for pointing out this very relevant reference and findings for comparison. We have included this reference (new reference #27).

The term readiness is used in line 430, not sure how this is being defined relative to availability.

Thank you for this suggestion. We have edited the sentence to indicate "availability of surgical equipment and medications" rather than "readiness."

VERSION 2 – REVIEW

REVIEWER	Michael Engelgau National Institutes of Health
REVIEW RETURNED	18-Jun-2020

GENERAL COMMENTS	The authors have responded to my comments in a reasonable fashion

REVIEWER	david Spiegel University of Pennsylvania
REVIEW RETURNED	19-Jun-2020

GENERAL COMMENTS	excellent paper